

THE ANNALS

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[EIGHTH SERIES.]

"..... per litora spargite muscum,
Naiades, et circum vitreos considite fontes:
Pollice virgineo teneros hic carpite flores:
Floribus et pictum, divæ, replete canistrum.
At vos, o Nymphæ Craterides, ite sub undas;
Ite, recurvato variata corallia trunco
Vellite muscosis e rupibus, et mihi conchas
Ferte, Deæ pelagi, et pingui conchylia succo."
N. Parthenii Giannettasi, Ecl. 1.

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I.—*The Anatomy and Classification of the Teleostean Fishes of the Orders Berycomorphi and Xenoberyces.* By C. TATE REGAN, M.A.

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[Plate I.]

THE Berycomorphous fishes are a group of considerable interest, for on the one hand they approach the Perches in general structure, and on the other they retain many features of generalization which indicate their relationship to primitive Clupeoids.

The order was well represented in Cretaceous times, and the fossil genera were included in the fourth volume of Dr. Smith Woodward's 'Catalogue of Fossil Fishes,' issued in 1901. The best descriptions and figures of the extinct species are those of W. von der Marck (Palæont. xi. 1863) and of Smith Woodward (Palæontogr. Soc. 1902). Dr. E. C. Starks has given a useful account of the osteology of some of the recent types, with figures of the crania of *Polymixia*, *Beryx*, *Hoplostethus*, *Monocentris*, and *Holocentrus* (Proc. U.S. Nat. Mus. xxvii. 1904); I fully agree with him that the Pempheridæ do not pertain to this order, but to the Percomorphi. The skeleton of *Holocentrus* has been figured by Agassiz (Poiss. Foss. vol. iv.) and that of *Beryx* by Günther ('Challenger' Deep-sea Fishes).

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In the following account both recent and extinct forms are dealt with, and the more important characters of the order and its component families are set forth; three families, Berycopsidæ, Diretmidæ, and Anomalopidæ, hitherto regarded as of uncertain affinities, are assigned a definite place in the system, and the Melamphaidæ, until now included in the Berycidæ, are rejected from the order.

Order BERYCOMORPHI.

Parietals separated by the supraoccipital; nasals large, posteriorly attached to the frontals; opisthotic well-developed, bounded in front by the pro-otic and below by the exoccipital; orbitosphenoid present, united by suture with the alisphenoids, but well separated from the mesethmoid; a Y-shaped basisphenoid present; a thin-walled auditory bulla, containing a large otolith, formed by the pro-otic, parasphenoid, basi-occipital, exoccipital, and sometimes the opisthotic. Mouth bordered above by the protractile præmaxillaries; maxillary articulated with the vomer and attached near its proximal end to the well-developed maxillary process of the palatine; one or two supramaxillaries; lower jaw of dentary, articulare and angulare. First pharyngo-branchial suspensory; third and fourth ankylosed; lower pharyngeals separate; three ossified basi-branchials. 4 gills; pseudobranchiæ; 7 to 9 branchiostegals. Hyo-palatine and opercular bones normally developed. Vertebral column of solid centra which are co-ossified with the arches; anterior ribs sessile; posterior ribs on parapophyses; hypurals more or less fused and expanded; three epurals (epaxial basalia) and two uroneurals. Post-temporal forked, attached to the epiotic and opisthotic; usually two post-cleithra on each side; no mesocoracoid; pectoral radials four, hourglass-shaped, only the lowest in contact with the hypocoracoid. Air-bladder without pneumatic duct*. Anterior rays of vertical fins spinous; pelvic fins thoracic or subabdominal, with or without spine and with from 3 to 13 soft rays; caudal fin typically with 19 principal rays, 17 of which are branched (18, with 16 branched, in the Polymixiidæ).

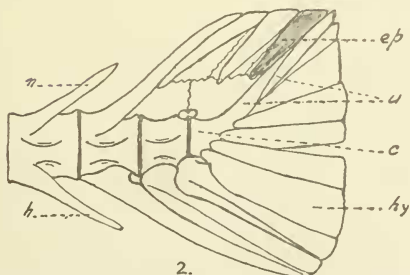
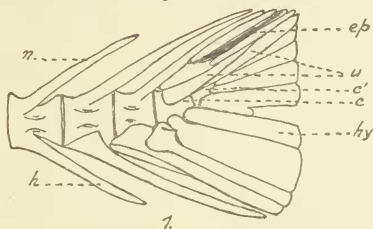
Family 1. Polymixiidæ.

Dorsal and anal fins long or moderately elongate, with a few graduated spines and rather numerous soft rays; caudal

* I cannot find a duct in any of the genera I have examined, including *Beryx* and *Holocentrus*, which are said to be physostomous.

with 16 branched rays; pelvics subabdominal, 7 or 8 rayed, without spine. Jaws with villiform teeth in bands; teeth on parasphenoid, vomer, palatines, pterygoids, and mesopterygoids. A pair of hyoid barbels. Upper edge of maxillary slipping under the præorbital and anterior suborbitals; two supramaxillaries, the posterior not overlapping the anterior; all the suborbitals forming a subocular shelf; nasals moderately large, separated in front by the præmaxillary

Fig. 1.



Skeleton of caudal fin of *Polymixia nobilis* (1) and *Hoplopteryx affinis* (2).

n, neural spine; *h*, hæmal spine; *ep*, epaxial basalia (epurals);
u, uroneurals; *hy*, hypurals; *c*, *c'*, centra.

processes and behind by the ethmoid, to which they are united by suture; supraoccipital and parietals not overlapped by the frontals, with prominent crests; occipital crest extending to anterior edge of frontals; alisphenoids separate, bridged by the orbitosphenoid. Hypocoracoids narrowed forwards below; pelvic bones remote from the cleithra. Vertebrae 28-34; last two centra upturned and anterior uroneural united with the penultimate centrum by suture.

In addition to the recent *Polymixia*, Lowe, the Cretaceous *Platycormus*, W. von der Marck, may be placed in this family; it has been well described and figured, and shows many important resemblances to the recent genus. The less satisfactorily known *Omosoma*, Costa, and *Pycnosterinx*, Heck., may be provisionally associated with *Platycormus*.

Family 2. Berycopsidæ.

Berycopsis elegans, Dixon, from the Chalk of Sussex and Kent, has been fully described and figured by Dr. Smith Woodward. It is in some respects intermediate between the Polymixiidæ and Berycidæ, but is well distinguished from both.

Dorsal and anal fins as in the Polymixiidæ; pelvic fins not well known, perhaps as in the Polymixiidæ; two supra-maxillaries formed as in *Beryx*, the posterior large and sending forward a pointed process above the anterior; pterygoid teeth present; occipital and parietal crests terminating above the middle of the orbit; suborbitals narrow, præorbital deep, and maxillary exposed; vertebræ at least 26 and perhaps as many as 30.

Family 3. Berycidæ.

Dorsal and anal with a few graduated spines; caudal with 17 branched rays; pelvics thoracic, of a spine and 7 to 13 soft rays. Jaws with villiform teeth in bands; teeth on vomer and palatines. Upper edge of maxillary slipping under præorbital and anterior suborbitals; two supra-maxillaries, the posterior sending forward a pointed process above the anterior; subocular shelf formed by several suborbitals, or at least extending the whole length of the second; nasals moderately large, separated by the præmaxillary processes, but nearly meeting above them anteriorly; supra-occipital and parietals not overlapped by the frontals, with prominent crests which extend forward on the latter to the interorbital region; frontals anteriorly with prominent ridges bordering mucus cavities; alisphenoids united by suture. Hypocoracoids not narrowed forward, reaching the ventral profile and forming a symphysis behind that of the cleithra; pelvic bones embraced by the hypocoracoids and attached to the cleithra above the symphysis. Vertebræ 24; no upturned centra, and the anterior uroneural ankylosed with the last centrum.

There are two very distinct genera, viz., *Beryx*, Cuv., and *Hoplopteryx*, Agass. The former, with species from the

North Atlantic and Japan, has the dorsal, with IV 13-19 rays, much shorter than the anal, which has III-IV 26-30; the pelvics have I 10-13 rays. The latter includes three recent species from South Australia and New Zealand, in which the dorsal, with VI-VII 12-14 rays, is longer than the anal, which has IV 12-15, whilst the pelvics have I 7 rays. Moreover, the spines are stouter than in *Beryx*, and the scales are larger and structurally different, being slightly rugose with strongly pectinated edges, instead of covered with little spines. There are several Cretaceous species of *Hoplopteryx*; in the Australian *H. affinis*, Günth., the crests and ridges on the head are arranged exactly as in the Cretaceous *H. lewisiensis* described and figured by Dr. Smith Woodward. I give a figure of *H. affinis*, for comparison with the extinct forms (Pl. I.).

Family 4. *Diretmidæ*.

The type of *Diretmus argenteus*, Johnson, is in the British Museum collection; it is evidently related to the Berycidæ. The dorsal and anal fins appear to be formed mainly of articulated rays, and probably not more than 3 or 4 are spinous; the caudal has 17 branched rays; each pelvic fin is composed of a laminar, oblong ovate, obliquely striated spine and 5 branched rays; (the pelvic spine of *Beryx* is obliquely striated). The scales are small, adherent, spinulose, differing from those of *Beryx* in that the bases of the spinules are expanded into parallel vertical ridges.

The jaws have narrow bands of villiform teeth, with a series of larger pointed teeth in the lower; the palate is toothless.

The single large supramaxillary has the form of the posterior supramaxillary of the Berycidæ; the nasals are separated by the præmaxillary processes; the subocular shelf and the alisphenoids and orbitosphenoids are as in the Berycidæ. The cranial crests and ridges are as in the Berycidæ, except that the paired ridges which converge forward from the parietal crests in the latter are now united to form a single median ridge, owing to the narrowness of the inter-orbital region. The thin-walled auditory bulla containing a large otolith can be seen above the gills. The pelvic bones are embraced by the enormously expanded hypocoracoids, which meet in a long symphysis; this is an exaggeration of the Berycid condition.

Family 5. *Trachichthyidæ*.

Dorsal and anal spines few; pelvic fins thoracic, of a spine and 6 soft rays. Jaws and dentition as in the Berycidæ, but

vomerine teeth sometimes absent and anterior supramaxillary wanting; a single large supramaxillary, superiorly sending forward a pointed process; subocular shelf a small or slender process of the second suborbital; nasals very large, united by suture throughout their length, covering the ethmoid and the præmaxillary processes. Frontals, parietals, and supra-occipital, with their ridges and crests, arranged much as in the Berycidae. Alisphenoids separate, bridged by the orbitosphenoid. Hypocoracoids narrowed forward below, not reaching the ventral profile, not embracing the pelvic bones, which are firmly attached to the cleithra above the symphysis. 26 vertebræ; no upturned centra, and the anterior uroneural ankylosed with the last centrum. Abdomen with a median series of ridged or serrated scales.

Recent genera are *Trachichthys*, Shaw, *Hoplostethus*, Cuv. & Val., *Paratrachichthys*, Waite, and *Gephyroberyx*, Bouleng. The Cretaceous *Aipichthys*, Steind., and *Aerogaster*, Agass., may be provisionally referred to this family. *Sphenocephalus*, Agass., shows some resemblance to *Trachichthys*, but does not seem to have the abdominal series of ridged scales.

Family 6. *Monocentridæ*.

Differs from the preceding only in the large, bony, rigidly united scales, the absence of the first four ribs, and the reduction of the pelvic fin to a spine and 3 soft rays. The trunk-muscles are inserted only on the posterior surface of the skull, and on the upper surface the occipital and parietal crests are converted into ridges bordering mucous channels.

One genus, *Monocentris*, Bl. Schn.

Family 7. *Anomalopidæ*.

Differs from the *Trachichthyidæ* in the absence of mucous channels on the head and in the presence of a peculiar evertible subocular luminous organ.

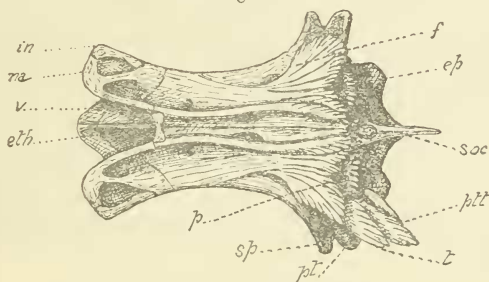
There is a single example of *Anomalops katoptron*, Bleek., in the British Museum, and I have ascertained that the nasal bones, the orbitosphenoid, and the supramaxillary are as in the *Trachichthyidæ*. There is a median abdominal series of ridged scales and the caudal fin has 17 branched rays. In this specimen the right pelvic fin is absent and the left has only 4 rays; these fins are said to be normally 6-rayed, but authors disagree as to whether the outer ray is spinous or articulated. *Protoblepharon palpebratus*, Bodd., which has been figured by Max Weber ('Siboga' Exped. p. 109, 1902)

seems to have I 6 pelvic rays, and is otherwise very similar to *Hoplostethus* or *Trachichthys*.

Family 8. Holocentridæ.

A long spinous dorsal; anal with 4 spines; caudal with 17 branched rays; pelvics thoracic, of a spine and 5 to 8 soft rays. Jaws and dentition as in the Berycidæ; two supra-maxillaries, the posterior large and sending forward a pointed process above the small anterior one; subocular shelf formed by several suborbitals; nasals moderate, separated by the præmaxillary processes, not convergent anteriorly; a second nasal bone on each side below the nostrils. Frontals large,

Fig. 2.



Skull of *Myripristis murdjan*, from above.

in, infra-nasal; *na*, nasal; *v*, vomer; *eth*, ethmoid; *soc*, supra-occipital; *f*, frontal; *p*, parietal; *sp*, sphenotic (post-frontal); *pt*, pterotic (supra-temporal); *ep*, epiotic; *t*, temporal plate; *ptt*, post-temporal.

overlapping the parietals and supra-occipital, which scarcely appear on the dorsal surface of the cranium; no parietal crests; occipital crest not extending on to the frontals, which have a pair of low longitudinal ridges bordering a median groove or channel, and posteriorly a varying number of ridges radiating backwards; trunk-muscles inserted only on posterior surface of skull, excavating large posterior temporal fossæ, which are roofed by the frontals. Hypocoracoids narrowed forward below, not reaching the ventral profile, not embracing the pelvic bones, which are loosely attached by ligament above the symphysis of the cleithra. Vertebrae 26 or 27; no upturned centra, and the anterior uroneural ankylosed with the last centrum.

Recent genera are *Adioryx*, Starks ('Science,' xxviii. 1908, p. 614), *Holocentrus*, Scopoli, *Myripristis*, Cuv. (with toothed maxillary), and *Ostichthys*, Langsdorff. The Cretaceous *Homonotus*, Dixon, seems to be near *Myripristis*; the fish described by Dr. Smith Woodward from the Chalk of Kent under the name *Trachithyoides ornatus* is known only from the skull, which is very similar to that of some recent species of *Myripristis*, although none of them show the principal frontal ridges quite so far apart posteriorly nor the radiating ridges so few. *Dinopteryx*, A. S. Woodward, with seven anal spines, may be provisionally placed in this family.

I propose the new generic name *Caproberyx* for the fish from the Chalk of Kent described by Dr. Smith Woodward under the name *Berycopsis major* (Palæontogr. Soc. 1902, p. 11, pl. ii. fig. 2). Of the vertical fins only the anal spines are known, but the head and pectoral arch are well preserved and indicate relationship to the Holocentridæ. In the short præmaxillary processes and the absence of a præopercular spine *Caproberyx* resembles *Myripristis*, in the expanded præ-orbital and the weak principal and numerous radiating frontal ridges *Holocentrus*. But it differs from both in the greater prominence of the occipital crest, which has the upper edge thickened and longitudinally ridged; in this and in some other features it shows considerable similarity to *Antigonia*, and it may be that this resemblance is due to real affinity and that *Caproberyx* is nearest of all the Berycoids to the Zeomorphi.

The Berycomorphi as above restricted do not include the Stephanoberycidæ and Melamphaidæ. These are probably derived from the same stock as the Berycomorphous fishes, resembling them in the structure of the protractile mouth, and in the caudal fin, which has 19 principal rays, 17 of which are branched, and the procurrent rays spinous. Not much importance can be attached to the presence of large mucous cavities on the head. They differ from typical Berycomorphi in the toothless palate, the absence of a subocular shelf, and the triangular shape of the single supramaxillary, but especially in the absence of an orbitosphenoid. I find that in both *Melamphaes* and *Stephanoberyx* the widely separated alisphenoids extend well forward between the orbits, but do not seem to be bridged by an orbitosphenoid*.

* I have had no skeletons for examination, and in these two genera, as in *Anomalops* and *Diretmus*, I have only been able to see the arrangement of the interorbital bones by a temporary displacement of one eye in a spirit-specimen.

I therefore propose provisionally to associate these fishes in a new order, which may be termed

XENOBERYCES.

The two families may be thus defined:—

1. *Stephanoberycidæ*.

Air-bladder with a pneumatic duct; dorsal and anal fins without spines; pelvics abdominal or subabdominal, without spine, 5- or 6-rayed. $3\frac{1}{2}$ gills. Nasal bones joined throughout their length.

Two genera:—*Stephanoberyx*, Gill, and *Malacosarcus*, Günth.

2. *Melamphaidæ*.

Dorsal and anal fins with a few slender graduated spines; pelvics thoracic, of a slender spine and 6 to 9 soft rays; pelvic bones well behind the cleithra. 4 gills. Nasal bones separate.

Principal genera:—*Melamphaes*, Günth., *Plectromus*, Gill, *Scopelogadus*, Vaill., *Anoplogaster*, Günth., and *Caulolepis*, Gill.

EXPLANATION OF PLATE I.

Hoplopteryx affinis, Günth. ($\times \frac{1}{2}$)

II.—*The Collections of William John Burchell, D.C.L., in the Hope Department, Oxford University Museum.*

IV. *On the Lepidoptera Rhopalocera collected by W. J. Burchell in Brazil, 1825-1830.* By E. G. JOSEPH, of Lincoln College, Oxford.

[Continued from ser. 8, vol. v. p. 346.]

VIII. *ACRÆINÆ*.

THE following paper contains an account of the *Acræinæ* that were captured by Burchell in Brazil. According to the interpretation at which I have arrived in consultation with Professor Poulton, F.R.S., and Mr. W. J. Kaye, *Actinote*